

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:

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Date of mailing
(day/month/year)

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Applicant's or agent's file reference

P932 - PCT

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/JP2004/019458

International filing date (day/month/year)

17.12.2004

Priority date (day/month/year)

22.12.2003

International Patent Classification (IPC) or both national classification and IPC

Int.Cl.⁷ **H01L33/00 H01L21/205**

Applicant

SHOWA DENKO K.K.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Date of completion of this opinion

19.01.2005

Name and mailing address of the ISA/JP

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WRITTEN OPINION OF THE
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International application No.

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Box No. I Basis of the opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

- ☐ a sequence listing
☐ table(s) related to the sequence listing

b. format of material

- ☐ in written format
☐ in computer readable form

c. time of filing/furnishing

- ☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

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Box No. IV Lack of unity of invention

1. ☐ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has:
- ☐ paid additional fees
 - ☐ paid additional fees under protest
 - ☐ not paid additional fees

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

- ☐ complied with
- ☒ not complied with for the following reasons:

The inventions of claims 1-8 are linked to be one another only in respect of the feature "a first layer which is in contact with the substrate is composed of silicon-doped Al_xGa_{1-x}N (0 ≤ x ≤ 1)". However, this feature is disclosed in a prior art document WO 02/17369 A1 (SHOWA DENKO K.K.), 28.02.2002. So the feature cannot be a special technical feature.

And there exists no special technical feature linking the inventions of claims 1-8 as to form a single general inventive concept among the inventions.

Therefore there are no technical relationship which is considered as "special technical feature" (PCT rule 13.2) among the claims 1-6. So this application contains the following groups of invention which are not so linked as to form a single inventive concept under PCT rule 13.2.

Group I : Claims 1, 2, 4-6, 9, 10
Group II : Claim 3
Group III : Claims 7, 8

4. Consequently, this opinion has been established in respect of the following parts of the international application:

- ☒ all parts.
- ☐ the parts relating to claims Nos. _____

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>3, 5, 6</u>	YES
	Claims	<u>1, 2, 4, 7-10</u>	NO
Inventive step (IS)	Claims		YES
	Claims	<u>1-10</u>	NO
Industrial applicability (IA)	Claims	<u>1-10</u>	YES
	Claims		NO

2. Citations and explanations

D1: WO 2002/17369 A1(SHOWA DENKO K.K.) 28.02.2002,
Claims 1,25, Pages 21,35-36
D2: JP 10-125608 A(SHOWA DENKO K.K.) 15.05.1998,
Whole document, Figures 1-17
D3: JP 2003-63895 A(NICHIA KAGAKU KOGYO KK) 05.03.2003,
Paragraph [0022]-[0024], Figure 1
D4: JP 2002-313739 A(NICHIA KAGAKU KOGYO KK) 25.10.2002,
Paragraph [0019]-[0021], Figures 1-3
D5: JP 2002-100575 A(NICHIA KAGAKU KOGYO KK) 05.04.2002,
Paragraph [0027]
D6: JP 2002-261032 A(NICHIA KAGAKU KOGYO KK) 13.09.2002,
Paragraph [0030]
D7: WO 2000/04615 A1(FUJITSU LIMITED) 27.01.2000,
Whole document

Claims 1, 2, 4, 7-10

The subject matters of claims 1, 2, 4, 7-9 and 10 do not appear to be novel with respect to D1. Claims 1, 2, 4, 7-9 and 10 relate to a first layer composed of silicon-doped Al_xGa_{1-x}N ($0 \leq x \leq 1$) which is in contact with the substrate. The first layer has a structure formed of aggregated columnar crystal grains. Such a first layer which is in contact with the substrate appears to be known from D1 (see [claims 1, 25, pages 21, 35 - 36]).

Claims 5, 6

The subject matters of claims 5 and 6 do not appear to involve an inventive step in view of D1 and D2.

D1 discloses a first layer composed of silicon-doped Al_xGa_{1-x}N ($0 \leq x \leq 1$) which is in contact with the substrate, and has a structure formed of aggregated columnar crystal grains.

D2 discloses a columnar crystal grains has a width of 50 nm, a thickness of 60 nm.

The Al_xGa_{1-x}N ($0 \leq x \leq 1$) layer which is in contact with the substrate in D1 and D2 are concerned with mutually related technical fields. Therefore, the skilled person in the art would easily conceive the idea of applying the technical features employed in D2 to the invention disclosed in D1.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: ∇

Claim 3

The subject matters of claim 3 does not appear to involve an inventive step in view of D1 and D3 (or D1 and D4).

D3 and D4 disclose the difference in height between a protrusion and a depression which are present at the interface between a buffer layer and a epitaxial film, so as to attain good crystallinity of the epitaxial film. A buffer layer between a substrate and a epitaxial film in D1, D3 and D4 are concerned with mutually related technical fields. Therefore, the skilled person in the art would easily conceive the idea of applying the technical features employed in D3 or D4 to the invention disclosed in D1.

Claims 1-8

The subject matter of claims 1-7 and 8 do not appear to involve an inventive step in view of D2 and D5 - D7.

D5 - D7 disclose a silicon-doped $\text{Al}_x\text{Ga}_{1-x}\text{N}$ ($0 \leq x \leq 1$) buffer layer. The $\text{Al}_x\text{Ga}_{1-x}\text{N}$ ($0 \leq x \leq 1$) buffer layer in D2 and D5 - D7 are concerned with mutually related technical fields. Therefore, the skilled person in the art would easily conceive the idea of applying the technical feature employed in D5 - D7 to the invention disclosed in D2.